Lab Assignment 2

Robotic Band

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Introduction

The objective of this project was to construct a robotic band consisting of two instruments that can be autonomously and human controlled. This document details the instruments, including what sensors, actuators, and code were used to produce sounds, sense the environment and interact with users.

Making Noise

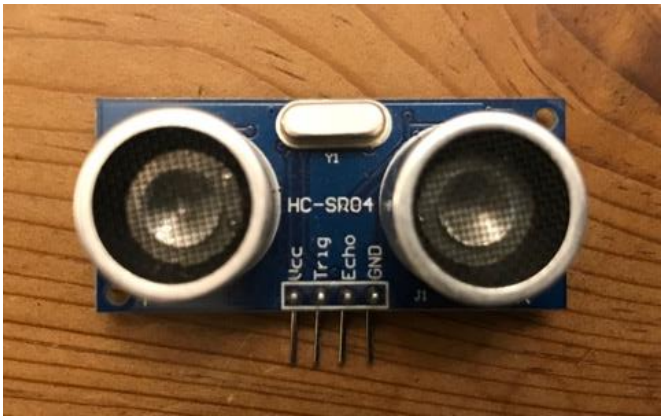
The actuators used to produce sounds include a piezo buzzer as well as a vibration motor. These are both transducers that convert electrical energy to acoustic energy. The vibration motor is wrapped in Styrofoam and attached to the back of a plastic cup in order to function as a speaker.

Piezo Buzzer

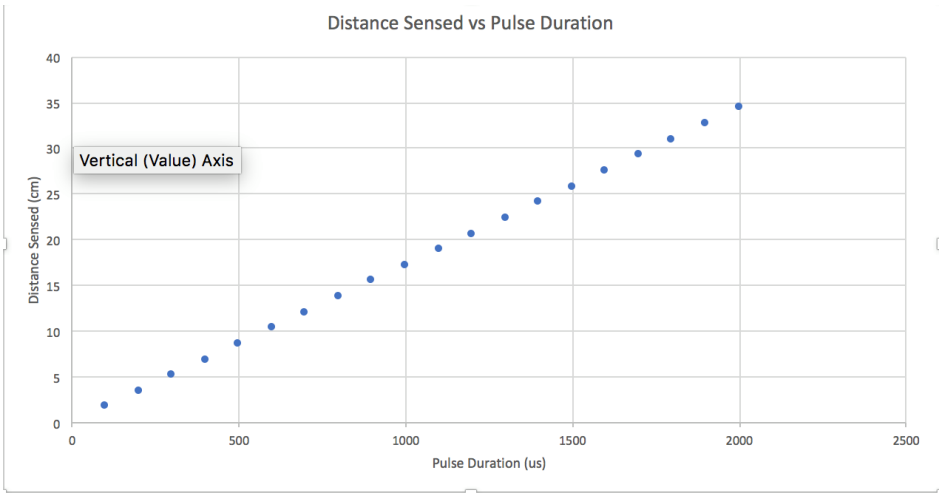
Vibration Motor Speaker

Sensing the Environment and Users

Two sensors are used to detect certain environmental states. These include a Parallax ultrasonic sensor and an Infrared sensor.

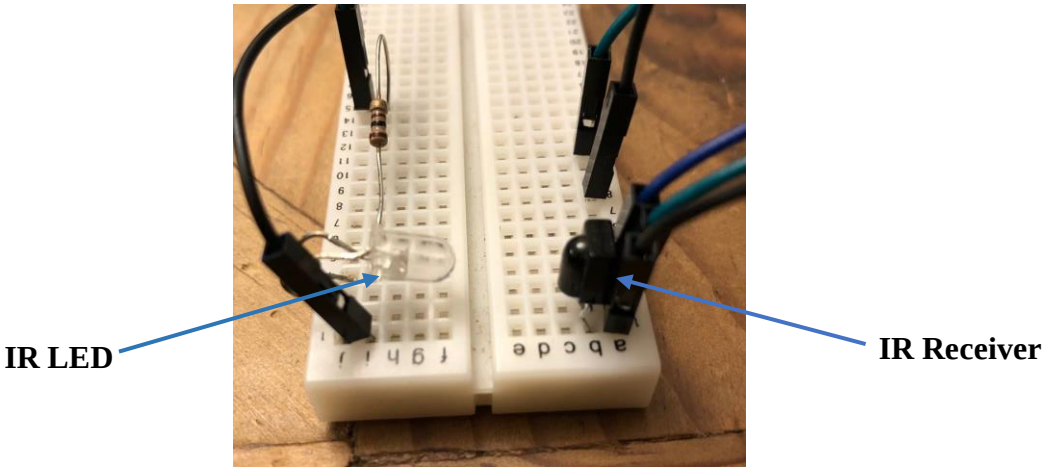


Pictured above is the ultrasonic sensor and is used to measure object distances from its speaker. This is used to trigger the vibration motor speaker to emit different frequencies based on certain distances.



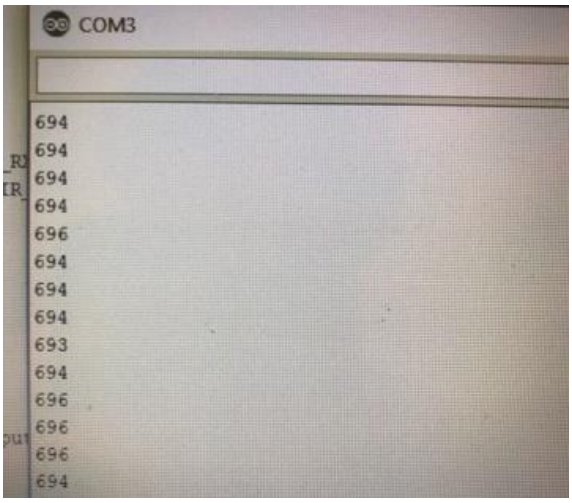
The graph above shows a plot of the distance sensed by the ultrasonic senor versus the pulse duration (time it takes to send and receive a pulse).

The above figure illustrates the notes that the vibration motor speaker will play for certain distances measured by the ultrasonic sensor.

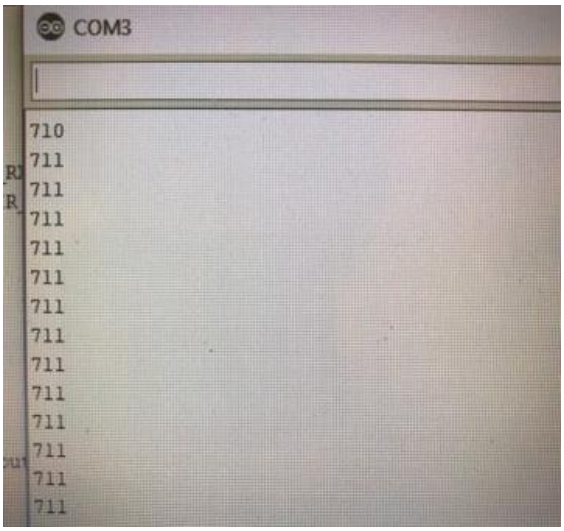


Pictured above is the set up for the IR sensor. An IR LED is pointed towards the IR Receiver which can measure whether or not there is an object blocking the path from the LED to Receiver. This is used to trigger the piezo buzzer to sound when the path is blocked.

An analog input is used to read in the values from the IR receiver. When the LED/Receiver path is blocked, the readings are:



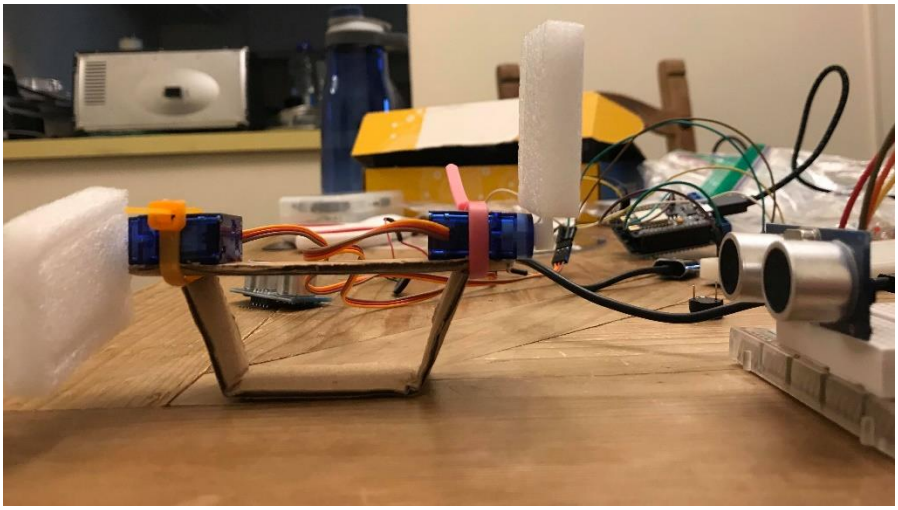
When the path is open, the readings are:



This data is used to determine when there is an object blocking the path and turn on the piezo buzzer.

Multi – Robot Collaboration

Servos are used to control the sound produced from the ultrasonic sensor / vibration motor circuit. The servos are positioned such that their arms are at certain distances from the sensor.



The above picture shows a state when the servo closer to the ultrasonic sensor has its arm up and when servo further away has its arm down. A certain frequency will be output from the vibration motor speaker in this state. When the closer servo has its arm down, a different frequency will be outputed.

User Interface

The user is able to turn ON and OFF the IR LED using the following user interface:

Code

The code used to implement this robotic band can be found in the following repository:

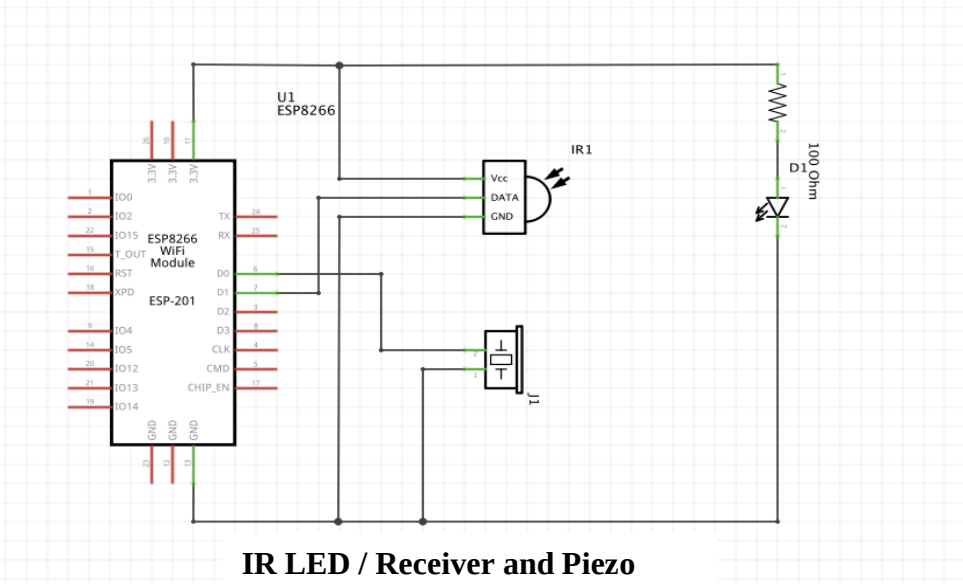
https://github.com/mayurbhandary/EE183DA-Lab2

Demonstrations

A video demonstrating the operation of the band can be found in the same repository. The video must be downloaded in order to view due to its size.

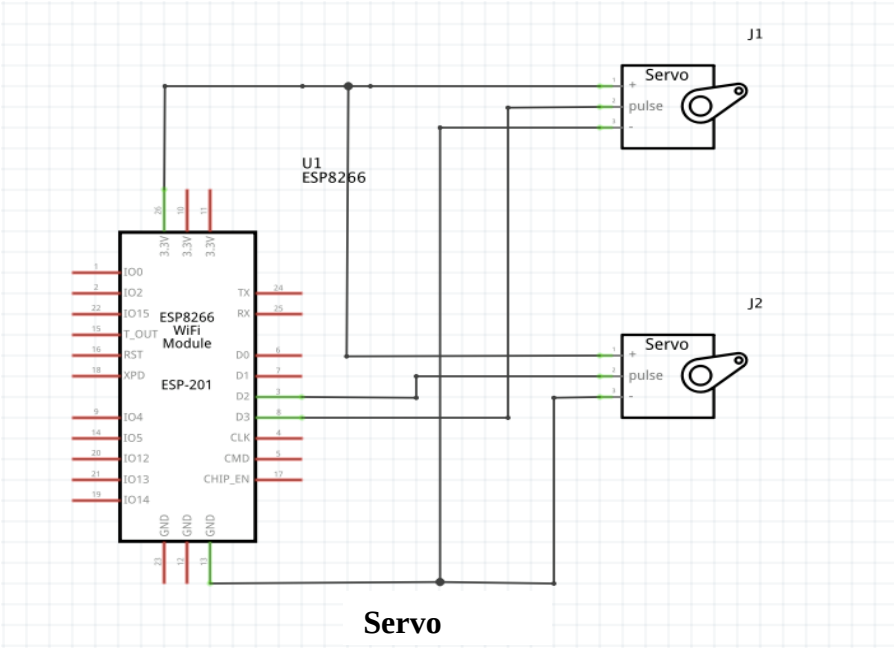
Schematics

The schematic below shows the IR LED training a signal towards the Receiver which will play out a sound from the Piezo Speaker. The ESP8266 module is WiFi controlled to either turn or off relative to the beats produced from the vibration motor.



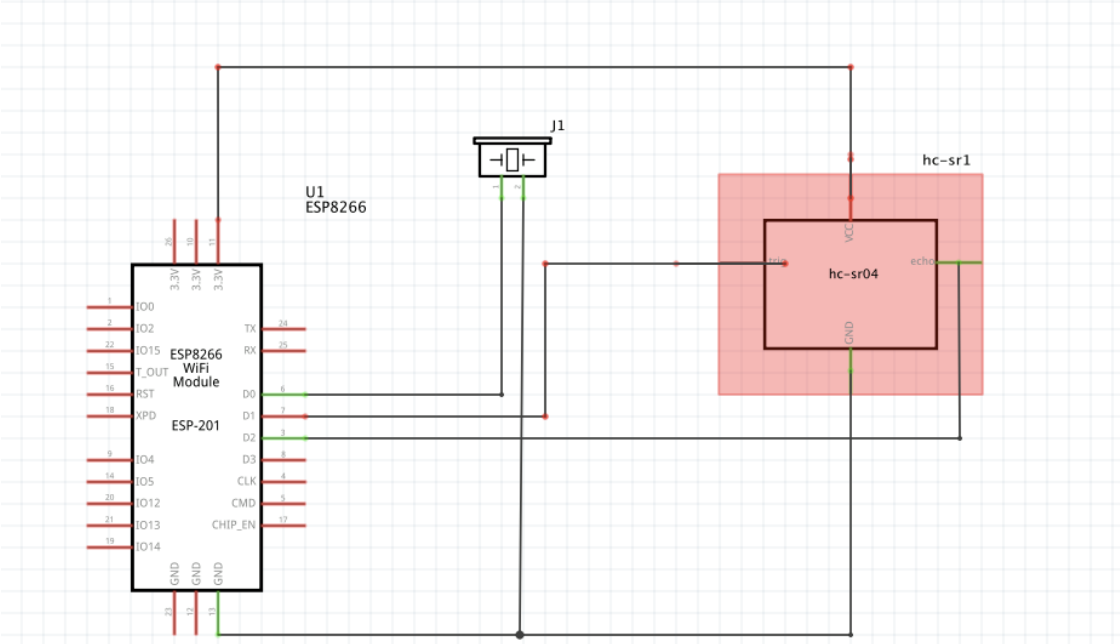
IR LED / Receiver and Piezo

The next schematic below shows the servo motors that function with notes that we as a team designed. The servo motors are both connected to the Vin and GND ports and are connected to digital ports on the ESP8266.



Servo

The schematic below shows the ultrasonic sensor connected to the microcontroller which then outputs noise through a vibration motor speaker. The servo motors from the previous circuit will produce various notes in front of the ultrasonic sensor which will then output through the vibration motor.



Ultrasonic Sensor and Vibration Motor Speaker

Bill of Materials

Materials	Part No.	Qty.	Cost	Description
Parallax Ultrasonic Distance Sensor	28015 (Parallax)	1	$29.99	Proximity Sensor
Continuous Rotation Micro Servo	2820 (Pololu)	2	$9.96	Micro 360 Continuous rotation analog servo
ESP8266 Wireless Module	1188-1153-ND (Digikey)	3	$18.27	Microcontroller
IR LED	1080-1084-ND (Digikey)	1	$0.42	IR LED
IR Receiver	TSSP58038-ND (Digikey)	1	$0.95	IR Receiver
Piezo Buzzer	PS1240 (Adafruit)	1	$1.50	Piezo Buzzer
Vibration Motor	1597-1200-ND (Digikey)	1	$2.55	DC Motor Vibration, ERM 12000 RPM 3VDC